Peak Factor for hourly design demands AND Water Tariff Plans for domestic water supply Distribution Systems for Rural Areas and Small Cities.

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ABSTRACT

This paper is for listing the parameters influencing the peak factor (PF) for design peak hourly demands (PD) for the design of domestic water pipe lines of the distribution system (DNS) for applicable to Developing countries like INDIA. The peak factor (PF) for the developed countries are nearly fixed (2 to 3) and from so many decades onwards the Peak Hourly Demands are stabilized w. r. to stakeholders' practices for 24X7 systems. But it is not just similar for Developing countries and involves so many parameters and increases the PF in many folds at the transition stage to overcome the hurdles for the target of 24X7 water availability at service level by the provision of Water Meters with implementation of affordable control Water TARIFF PLANS.

INTRODUCTION

Just assuming a peak factor (PF) on par with the developed countries for its adoption to the developing countries will not feasible. A few more attempts were not fully succeeded for sustaining the 24X7 systems which are not aware of practice the circumstances in developing countries to meet the peak demands at the initial stages of implementation of 24X7 systems. The peak factor for hourly demands is depends on so many parameters (as per Table 1.0) in developing countries as limited resources and lack of much importance for public health leads other than technical hurdles too and creates the abnormal situations to succeed the 24X7 systems.

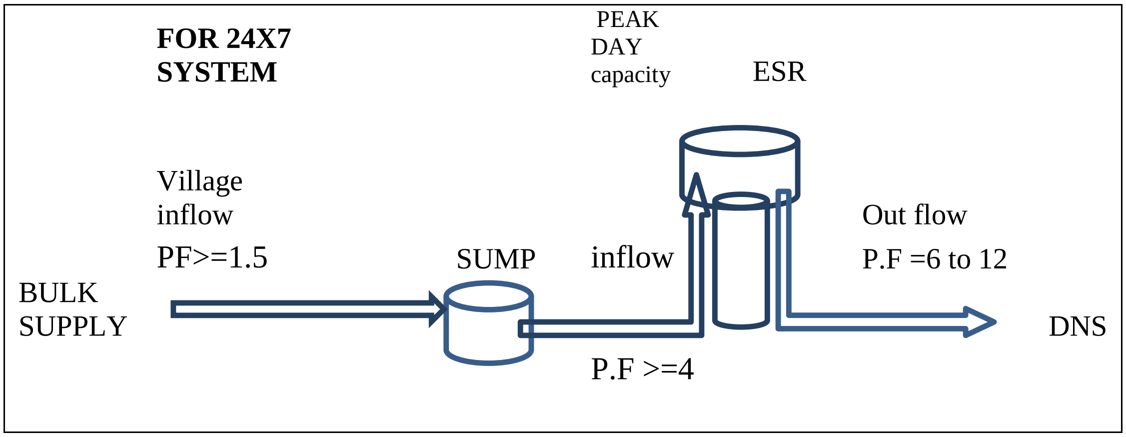
In most places of INDIA the water supply systems flow patterns are not similar to the 24X7 systems which are adopting in developed countries. In general, the 24X7 systems,

the water is pumped continuously (24X7) to a distribution pipe network with average discharges, then reaches to consumers directly for instant use and during lesser demand periods (in nights) the excess pumped water to the DNS causes to rise the system pressure then the surplus water moved to an elevated storage tank (floating on DNS) and thus water balancing takes place from both the ways to meet the peak hour demands without drop in required residual heads in the DNS.

This type of 24X7 system depends on clear water availability (24X7), power supply by 24X7, initial sufficient funds, systematic users (habituated to 24X7 system that not to collect water for storage of entire day demands) and appropriate system designs to suit all the situations.

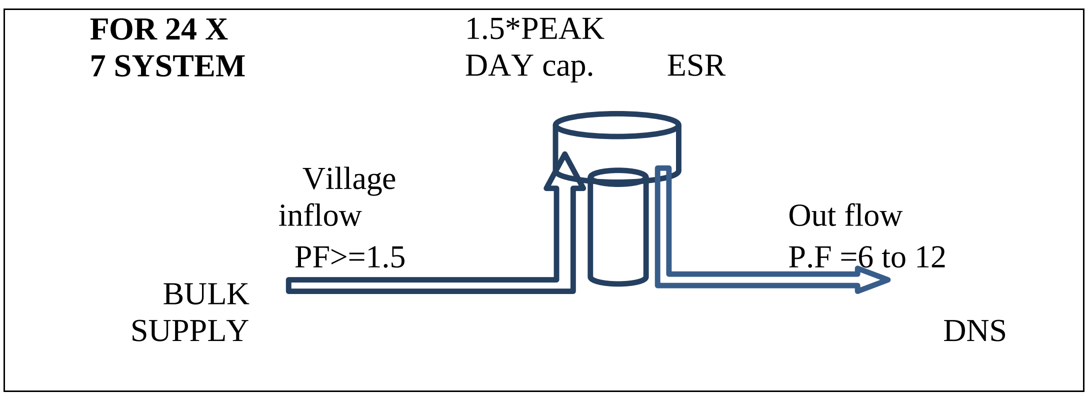
In India the general practices of Drinking water supply systems, the water is collected to an Elevated storage tank by available provision of pumping/gravity then the stored water is distributed by gravity from the tank to the consumers at the peak demand periods (in real grounds PF 24 to 48 instead of 3 as per ref[2] and the water carrying capacity of an individual 15mm size tap around 1300 LPH for 6m residual heads) thus intermittent supply takes place which leads clear water contamination and improper distribution etc.,. From the usual design practice, all the components capacities are establishing in lines of 24X7 systems adopting in developed countries as explained in above paragraphs. The parameters adopting for 24X7 system's (flow pattern & units alignments) for developed countries environments will not suitable for the Indian environments with limited resources (water and power) and at the transition stage from the intermittent supply. The design parameters such as peak factors for design of DNS & transmission pipe lines, capacities for Ground Level storage/Elevated storage Tanks and per capita water design demands, are based on water & power availability and the 24X7 system flow pattern & units alignments has to be suitably planned & designed for the Indian environments appropriately with the available resources. Models for 24 X7 systems for Indian Environments given in FIG 1.0A &1.0B are suitable and adoptable for design demands not less than 100 LPCD @ service level excluding the total losses around 30% (losses as per ref [1]), to be allowed in designs for the systems at the transition stage from the intermittent supply).

FIG 1.0 A -VILLAGE SYSTEM feed from BULK SUPPLY FROM SUB GRID WITH SUMP



NOTE 1. Village Storage tanks with 1.5* Peak Day Demands in total.
NOTE 2. Pipe lines to be designed for individual Peak Factors as mentioned.
NOTE 3. For Individual WTP small cities in place of sump replaced by WTP

FIG 1.0 B -VILLAGE SYSTEM feed from BULK SUPPLY FROM SUB GRID



NOTE 1. Storage tanks with 1.5* Peak Day Demands
NOTE 2. Pipe lines to be designed for individual Peak Factors as mentioned
NOTE 3. The conveying main (for inflow) very long, the reservoir should contain preferably three days supply as per ref [3].

The peak factor (PF) for peak hourly demand depends up on the following parameters for TABLE 1.0

Sl no	Influencing Parameter	Parameter's variations	Field Variation of PF with parameter
1	The Per capita design demand for Domestic Water Supply	For less than the required demand	PF increases
2	Hours of Continuous quality Power Supply availability in a day	on less hours power supply availability	PF increases
3	Density of Population	on increase	PF decreases
4	Country development Growth Rate	on increase	PF decreases
5	Availability of water quantity	on decrease	PF increases
6	Water Scarcity	more Scarcity	PF increases
7	Consumer's health awareness and Education.	Less awareness	PF increases
8	Poverty alleviation	On Less alleviation	PF increases
9	Rate of Water Tariff over O&M cost	on increase	PF decreases
10	Provision of Minimum Residual Head	on increase	PF decreases
11	For consumers status, the systematic consumers.	More systematic consumers	PF decreases
12	Inflow (Pumping/Gravity) Fixed Rate/varied Rate of flow to the DNS in times of average demand	On Varied inflow based on demand	PF decreases
13	On Dry season	On drought period	PF increases
14	Capacity of ESR with respect to day DEMAND	more capacity than design day demands	PF decreases
15	System Reliability	Less Reliability	PF increases
16	Per capita SYSTEM COST	For inadequate cost	PF increases
17	Storage at Household (HH)	For more storage	PF increases
18	Minimum pipe size of service connections	For pipe sizes decrease	PF decreases
19	Consumer Water conservation	More conservation	PF decreases
20	on Social/Religion/Region-effects	For area more Multicultural living	PF decreases
21	Local working environments by shift-system, for more working hours for day & nights.	For more shifts	PF decreases

From the above observations the expected peak factors for peak hour discharge for design of Main pipe lines for Distribution systems are given in TABLE 2.0,may be applicable for Developing countries by provision of Water Meters with implementation of affordable control Water TARIFF PLANS (Annexure –A, for expected 2020 year social status for people conditionings in TELANGANA STATE in INDIA) with 150% to 200% average day demand storage at Elevated service reservoir (or combined capacity with Ground Level Storage tanks) with minimum of 1.5 Peak Factor for Transmission System for inflow capacities to reservoirs. (Maximum of 16 hours pumping (inflow), as per page 123 of ref [4]

TABLE 2.0 PEAK FACTOR FOR PEAK HOURLY DEMANDS FOR DNS DESIGN

		24X7 WATER AVAILABILITY POSSIBLE ZONE					
sl no	population command by DNS	peak factor for Distbn Mains-for **200** LPCD	peak factor for Distbn Mains-for 165 LPCD	peak factor for Distbn Mains-for 135 LPCD	peak factor for Distbn Mains-for **100** LPCD	peak factor for Distbn Mains-for 70 LPCD	peak factor for laterals
1	< 2000	9	9	12	12	24	24
2	2,000-5,000	6	7	8	9	24	24
3	5,000-10,000	5	6	7	8	16	24
4	10,000-50,000	5	6	7	7	16	24
5	> 50,000	4	5	5	6	12	24

CONCLUSIONS

In most places of INDIA the water supply systems flow patterns are not similar to the 24X7 systems which are adopting in developed countries. In general, the 24X7 systems, the water is pumped continuously (24X7) to a distribution pipe network with average discharges, then reaches to consumers directly for instant use and during lesser demand periods the excess pumped water to the DNS causes to rise the system pressure then the surplus water moved to an elevated storage tank (floating on DNS) and thus water balancing takes place from both the ways to meet the peak hour demands without drop in required residual heads in the DNS. This type of 24X7 system depends on clear water availability (24X7), power supply by 24X7, initial sufficient funds, systematic users

(habituated to 24X7 system that **not to collect** water **for storage** of entire day demands) and appropriate system designs to suit all the situations.

In India the general practices of Drinking water supply systems, the water is collected to an Elevated storage tank by available provision of pumping/gravity and then the stored water is delivered by gravity from the tank to the consumers at the peak demand periods and thus tank gets empty in abruptly within minutes for daily once supply and leads to alternate day supply to increase the time of supply for withstanding the pressures at least for certain extent. From the usual design practice, all the components capacities are establishing in lines of 24X7 systems that are adopting in developed countries. The parameters adopting for 24X7 system's (flow pattern & units alignments) for developed countries environments will not suitable for the Indian socio-economic-environments with limited of resources (water and power).

The design parameters such as peak factors for design of DNS & transmission pipe lines, capacities for Ground Level storage/Elevated storage Tanks and per capita water design demands, are based on water & power availability and the 24X7 system flow pattern & units alignments has to be suitably planned & designed for the Indian environments appropriately with the available resources.

The peak factor for hourly demands is depends on so many parameters (as per Table 1.0) in developing countries as limited resources and lack of much importance for public health leads other than technical hurdles too and creates the abnormal situations to succeed the 24X7 systems. The expected peak factors for peak hour discharge for design of Main pipe lines for Distribution systems are given in TABLE 2.0,may be applicable for Developing countries by provision of Water Meters with implementation of affordable control Water TARIFF PLANS (Annexure –A, for expected 2020 year social status for people conditionings in TELANGANA STATE in INDIA) with 150% to 200% average day demand storage at Elevated service reservoir (or combined capacity with Ground Level Storage tanks) with minimum of 1.5 Peak Factor for Transmission System for inflow to reservoirs. Models for 24X7 systems for Indian Environments given in FIG 1.0A &1.0B are suitable and adoptable for design demands not less than 100 LPCD @ service level

excluding the total losses around 30% (as per CPHEEO O&M manual for UFW, considered in designs for the system reliability).

ANNEXURE A: WATER TARIFF FOR RURAL & URBAN AREAS

	water usage in lpcd			monthly charges			basic O&M Charges= Rs 10 per 1 kL		
block tariffs level	FROM	TO	monthly consumption in kL for 5 members in each HH	times over basic O&M cost	Tariff rate in Rs per 1 kL	**max** monthly charges on water meter reading	min other charges for each water meter connection	Total monthly water bill in Rs per month	remarks
0	0	55	8	**free on water meter reading**			50	50	subsidy @ 55 lpcd
1	56	70	10	1	10	20	50	70	basic @ 70 lpcd
2	71	100	15	2	20	120	50	170	1st control
3	101	135	20	4	40	320	50	370	2nd control
4	136	150	25	8	80	720	50	770	3rd control
5	156	200	30	12	120	1320	50	1370	4rth control
	>	200	30	12	120	1320	50	1370	leads disconnection

NOTES ON ANNEXURE for controlled WATER TARIFF PLAN

1. Subsidy for basic national minimum service level @ 55Lpcd and as per NRDWP norms [5] and basic min charges fixed without financial discrimination up to 70Lpcd consumption. This subsidy provision is made for all domestic consumers without the financial discrimination for encourage of metered connections to avoid the political litigations if any.
2. For residentially living in apartments and combined houses, each house-hold is considered as a unit for consumption tariff for preparation of water bills
3. More number of house-holds (families) lives in a single house/apartment, the tariff is considered based on average consumption for each household.
4. The installation & maintenance of water-meters is laborious and costly for both consumers & G.Ps hence combined connections may be better at this initial stage of water metering.

5. For poor residentially living in slum areas combined water connection can be given based on their request nearby the small huts/houses ,each house-hold is considered as a unit for consumption tariff for preparation of water bills but the house-holds who connected with water service line is responsible for making payments.
6. The basic O&M charges for residential is fixed yearly based on the actual expenditure incurred in the previous year.
7. The water quantity requirements for each family is considered as 5 members in average. (May be proportional to the family members for each HH such that the monthly consumption slabs varies by each HH and to be arrived based on actual per capita consumption duly considering the subsidy and controlling factors in lines of control water tariff plan as arrived in ANEXURE A)
8. The basic O&M charges for commercial buildings is 12 times over Basic O&M of residential charges, i.e.,Rs 120 per each kL without subsidy and direct charges applied based on the quantity of consumption., water charges =Total qty in kL X 120
9. The basic O&M charges for schools/hostels/hospitals/govt offices is 4 times over Basic O&M of residential charges, i.e.,Rs 40 per each kL

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